AEROLOGICAL OBSERVATIONS

By RICHMOND T. ZOCH

Free-air temperatures were above normal at all stations excepting Groesbeck. At most levels the departures were large. (See Table 1.)

Free-air relative humidities were below normal at nearly all of the levels at all of the aerological stations. Free-air vapor pressures were also below normal at most of the levels at all the stations. Although the vapor pressures were also below normal at most of the levels at all the stations. The total precipitation for the month was considerably above normal at Due West and Royal Center. At the other stations the total precipitation for the month was below normal.

A comparison of Table 1 with Table 2 brings out the effect of nearby bodies of water on the free air temperatures and relative humidites. The effect is large in the lower levels but small in the higher levels.

Free-air resultant winds were mostly westerly in the lower levels. At the 1,500 meter level and above they were mostly northwesterly. In general it may be said that the resultant wind velocities were greater than for previous months of July and that the southerly component was less pronounced than in previous months of July.

TABLE 1.—*Free-air temperatures, relative humidities, and vapor pressures during July, 1930*

TEMPERATURE (° C.)

Altitude (meters) m. s. l.	Broken Arrow, Okla. (233 meters)		Due West, S. C. (217 meters)		Ellendale, N. Dak. (444 meters)		Groesbeck, Tex. (141 meters)		Royal Center, Ind. (225 meters)	
	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal
Surface	26.9	+0.3	27.4	+0.5	23.4	+2.4	24.5	−2.1	25.8	+0.9
500	26.8	+1.9	25.4	+1.2	23.2	+2.6	23.7	−0.2	23.6	+1.5
1,000	24.3	+2.1	22.5	+1.5	21.0	+3.0	22.0	+.3	20.5	+1.9
1,500	20.6	+1.4	18.7	+1.1	18.3	+2.7	19.0	−0.1	16.9	+1.5
2,000	17.1	+0.9	15.2	+0.9	15.6	+2.7	15.7	−0.7	14.1	+1.6
2,500	13.8	+0.7	11.7	+0.6	12.1	+2.1	12.4	−1.1	11.4	+1.6
3,000	10.5	+0.6	8.3	+0.2	8.6	+1.5	9.6	−1.0	9.2	+2.1
4,000	4.2	+0.1	1.1	−1.2	1.9	+0.5	4.4	−0.2	4.1	+2.6
5,000	−0.8	+0.3							0.1	+4.8

TABLE 1.—*Free-air temperatures, relative humidities, and vapor pressures during July, 1930—Continued*

RELATIVE HUMIDITY (%)

Altitude (meters) m. s. l.	Broken Arrow, Okla. (233 meters)		Due West, S. C. (217 meters)		Ellendale, N. Dak. (444 meters)		Groesbeck, Tex. (141 meters)		Royal Center, Ind. (225 meters)	
	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal
Surface	62	−7	66	−1	58	−11	79	+4	54	−8
500	55	−11	64	−5	58	−10	75	−2	55	−9
1,000	52	−11	63	−7	53	−9	58	−9	55	−12
1,500	53	−9	65	−7	50	−8	57	−5	56	−10
2,000	53	−6	66	−6	46	−9	59	0	52	−10
2,500	48	−10	69	−3	45	−8	62	+4	46	−10
3,000	47	−11	68	−3	44	−7	58	+1	41	−9
4,000	46	−12	90	+22	42	−8	48	−12	31	−10
5,000	44	−12							45	+4

VAPOR PRESSURE (*mb.*)

Surface	21.63	−2.40	23.55	+0.33	16.63	−0.48	24.40	−1.23	17.66	−1.83
500	19.21	−1.74	20.36	−0.02	16.49	−0.05	21.77	−0.71	15.81	−1.20
1,000	15.90	−1.13	15.69	−1.15	13.07	+0.23	15.16	−1.85	13.14	−1.23
1,500	13.05	−0.79	13.04	−1.10	10.34	+0.05	12.54	−0.95	10.96	−0.59
2,000	11.00	+0.04	10.73	−0.84	7.93	−0.35	10.60	−0.37	8.49	−0.36
2,500	7.53	−1.27	8.91	−0.42	6.02	−0.69	9.31	+0.28	6.69	+0.20
3,000	6.04	−1.14	7.74	+0.08	4.36	−1.04	7.55	−0.06	5.16	+0.29
4,000	4.14	−0.68	5.94	+0.96	2.29	−1.51	4.64	−1.12	3.25	+0.43
5,000	2.84	−0.68							2.04	+0.26

TABLE 2.—*Free-air data obtained at naval air stations during July, 1930*

Altitude (meters) m. s. l.	TEMPERATURE (°C.)					RELATIVE HUMIDITY (%)				
	Hampton Roads, Va.	Pensacola, Fla.	San Diego, Calif.	Seattle, Wash.	Washington, D. C.	Hampton Roads, Va.	Pensacola, Fla.	San Diego, Calif.	Seattle, Wash.	Washington, D. C.
Surface	26.3	26.3	23.3	18.1	25.0	69	85	68	61	66
500	23.7	24.3	20.9	14.1	22.6	64	79	67	70	62
1,000	21.5	22.8	24.0	11.8	20.8	54	70	38	74	56
2,000	14.6	16.7	20.7	8.9	15.0	62	67	26	52	53
3,000	8.5	10.5	12.2	4.9	9.3	60	68	39	42	49
4,000				−1.1	3.4				48	43
5,000					−2.0					43

TABLE 3.—*Free-air resultant winds (meters per second) based on pilot-balloon observations made near 7 a. m. (E. S. T.) during July, 1930*

Altitude (meters) m. s. l.	Broken Arrow, Okla. (233 meters)		Burlington, Vt. (132 meters)		Cheyenne, Wyo. (1,873 meters)		Due West, S. C. (217 meters)		Ellendale, N. Dak. (444 meters)		Groesbeck, Tex. (141 meters)		Havre, Mont. (762 meters)		Jacksonville, Fla. (65 meters)		Key West, Fla. (11 meters)		Los Angeles, Calif. (145 meters)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
	°		°		°		°		°		°		°		°		°		°	
Surface	S 14 W	1.6	S 7 W	2.0	N 74 W	2.2	N 86 W	1.2	N 40 W	1.5	S 19 W	1.5	S 85 W	0.4	S 55 W	2.9	S 72 E	2.3	N 51 W	1.8
500	S 34 W	7.3	S 47 W	3.7			N 57 W	4.6	N 40 W	1.3	S 42 W	8.6			S 72 W	6.5	S 69 E	5.0	N 86 E	1.0
1,000	S 44 W	8.0	N 80 W	3.9			N 55 W	4.3	S 83 W	2.6	S 26 W	6.7	S 72 W	1.3	S 68 W	5.8	S 61 E	5.1	N 84 E	1.1
1,500	S 45 W	4.6	N 67 W	5.3			N 57 W	4.3	N 69 W	4.6	S 1 W	4.9	N 67 W	3.2	S 65 W	4.1	S 62 E	4.5	N 67 W	1.5
2,000	S 60 W	2.4	N 70 W	8.0	N 82 W	3.8	N 62 W	4.3	N 58 W	6.0	S 11 E	4.5	N 79 W	3.8	S 68 W	2.7	S 65 E	3.8	S 77 W	2.7
2,500	S 69 W	2.4	N 75 W	8.7	S 54 W	4.2	N 68 W	3.8	N 59 W	7.4	S 27 E	3.6	N 87 W	5.4	S 39 W	2.4	S 64 E	3.5	S 45 W	3.2
3,000	S 65 W	2.3	N 69 W	6.7	S 56 W	2.7	N 69 W	3.8	N 67 W	9.3	S 29 E	3.5	S 81 W	7.2	S 24 W	2.1	S 59 E	3.6	S 29 W	3.6
4,000	S 47 E	0.6	N 72 W	0.6	S 83 W	2.3	N 62 W	4.0	N 71 W	10.9	S 38 E	3.6	S 80 W	10.1	S 10 W	1.9	S 56 E	3.3	S 17 W	3.2
5,000	S 88 E	1.6			N 79 W	4.0	N 59 W	3.8	N 70 W	12.6	S 48 W	3.6	S 81 W	13.5	S 1 W	0.4	S 80 E	3.6		

TABLE 3.—*Free-air resultant winds (meters per second) based on pilot-balloon observations made near 7 a. m. (E. S. T.) during July, 1930*—Continued

Altitude (meters) m. s. l.	Medford, Oreg. (410 meters)		Memphis, Tenn. (145 meters)		New Orleans, La. (25 meters)		Omaha, Nebr. (321 meters)		Royal Center, Ind. (225 meters)		Salt Lake City, Utah (1,294 meters)		San Francisco, Calif. (8 meters)		Sault Ste. Marie, Mich. (198 meters)		Seattle, Wash. (14 meters)		Washington, D. C. (10 meters)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
	°		°		°		°		°		°		°		°		°		°	
Surface	S 24 W	0.4	S 36 W	0.9	N 67 W	0.6	S 23 E	0.9	S 8 E	0.8	S 26 E	3.3	N 33 E	0.1	N 60 W	0.7	S 19 E	0.3	N 86 W	0.4
500	S 72 W	0.9	N 81 W	3.2	N 70 W	4.2	S 26 W	4.6	S 63 W	3.2			S 7 W	2.3	N 56 W	3.2	S 5 W	0.7	N 62 W	4.2
1,000	N 61 W	1.5	N 72 W	4.1	N 64 W	2.8	S 62 W	8.6	N 72 W	5.4			N 31 W	1.7	N 62 W	4.6	N 7 W	0.3	N 56 W	6.5
1,500	N	0.8	N 61 W	4.1	N 6 W	0.6	S 75 W	6.7	N 56 W	5.7	S 20 E	5.7	N 47 E	0.7	N 62 W	7.6	N 25 W	1.0	N 58 W	6.6
2,000	N 73 E	0.4	N 63 W	3.4	N 84 E	1.1	S 84 W	5.5	N 60 W	7.5	S 2 W	5.4	S 87 E	1.0	N 62 W	8.9	S 2 E	0.9	N 60 W	7.9
2,500	S 31 W	3.5	N 62 W	2.4	S 69 E	2.1	S 89 W	4.4	N 51 W	8.7	S 22 W	3.1			N 60 W	10.0	S 29 W	2.4	N 69 W	8.0
3,000	S 30 W	5.5	N 74 W	1.8	S 74 E	2.5	S 87 W	4.8	N 53 W	9.7	S 48 W	3.0			N 57 W	10.6	S 33 W	2.9	N 64 W	8.5
4,000	S 36 W	7.9	N 58 W	3.0	S 70 E	2.8	N 75 W	6.2	N 53 W	11.5	S 42 W	3.9			N 53 W	12.0	S 49 W	5.1	N 65 W	9.7
5,000			N 55 W	3.5	N 78 E	3.4	N 75 W	7.4	N 54 W	9.7	S 33 W	4.1			N 47 W	13.6	S 47 W	8.5		

TABLE 4.—*Observations by means of kites, captive and limited-height sounding balloons during July, 1930*

	Broken Arrow, Okla.	Due West, S. C.	Ellendale, N. Dak	Groesbeck, Tex.	Royal Center, Ind.
Mean altitudes (meters), m. s. l., reached during month	3,058	2,592	3,074	2,226	3,347
Maximum altitude (meters), m. s. l., reached and date	[1] 6,397	[2] 4,585	[3] 4,939	[4] 4,029	[5] 7,171
Number of flights made	31	29	32	25	28
Number of days on which flights were made	30	29	29	25	27

[1] 30th. [2] 11th. [3] 25th. [4] 23rd. [5] 3d.

In addition to the above there were approximately 125 pilot balloon observations made daily at 53 Weather Bureau stations in the United States.

WEATHER IN THE UNITED STATES

THE WEATHER ELEMENTS

By H. C. HUNTER

GENERAL SUMMARY

July was one of the hottest months in the history of the Weather Bureau, also one of the driest summer months Only small portions of the country had either more rain or lower average temperature than the mean of other Julys. The dryness was intense mainly in those east-central and south-central districts which were sorely in need of moisture when the month began, but other districts, especially to northward and westward, received very little rainfall in July. The heat was felt widely for considerable periods of time, and high marks occurred at great numbers of stations. In the Missouri Valley every first-order station recorded 100° or higher; in the upper Mississippi Valley, 9 out of 15; in the Ohio Valley and Tennessee, 14 out of 16; in the east Gulf area, 9 out of 12; and in the Middle Atlantic States, 11 out of 18.

TEMPERATURE

The first half was mainly warmer than normal, save in the Lake region and the Northeastern States and in portions of the Southwest. Unusual heat prevailed in the Plains and the northern Rocky Mountain region, also after the 5th in the central valleys and most of the Southeast.

The final half was a period of record-breaking heat in many northern and middle portions east of the Rocky Mountains, but in the southern portion and the far West the temperatures usually averaged about normal.

For July as a whole the temperature averaged above normal in nearly all sections, only five States of the far West, in addition to New York and New England, finding the month of but normal temperature or slightly lower. Generally from the interior portions of the Middle and East Gulf States northwestward to the middle and northern Plains the month averaged 4° to 7° hotter than normal. It was among the hottest ever recorded from the northern and middle Plains southeastward to the southern Middle Atlantic States and the South Atlantic and East Gulf States, though stations close to the seacoast usually found it from 1° to 4° less hot than the hottest month of previous record.

At Little Rock, Ark., the month was 1.4° hotter than any previous month in a 50-year record; at Tampa, Fla., the month was 0.5° hotter than any previous July in a 40-year record, though failing to equal August, 1924; at Chattanooga, Tenn., the month was warmer than any August or any previous July in a record of 51 years, though not quite so hot as September, 1925; and at Atlantic City, N. J., the month was exceeded by but two previous months in a record of 56 years. At Washington, D. C., the month was the hottest in almost 60 years, save July, 1872, which slightly exceeded it, and Julys of 1876 and 1887, which practically equaled it. Numerous places with records for 20 to 40 years found no other month so hot.

From Pennsylvania northeastward and in the Lake region the July average was not extraordinary, and this was the case over much of the Southwest and the far West, save near the southern California coast.

Remarkably high temperatures were experienced during several periods of the month. The highest marks in portions of the northern Plains and in much of the Southeast occurred about the 12th. In the southern portion of the Lake region, the Middle Atlantic States and much of the Ohio Valley the top marks were noted about the